STAT

Conversion of U_3O_8 to uranium and radium

The uranium ores are evaluated on the basis of their uranium or radium content.

After determination of the U_3O_8 content of the uranium ores by chemical analysis, the uranium, resp. radium content is determined according to the following relations:

I. Corresponding to its chemical composition, U_3O_8 contains 84.81 % uranium, i.e. 1 kg of U_3O_8 corresponds to 0.8481 kg of uranium.

II. According to Boltwood, the ratio between uranium and radium in pitchblende is:

$U/Ra = 3.3 \times 10^{-7}$ Ra, i.e.

1 kg uranium equals 0.33 mg radium.

III. If the radium contant is to be determined directly from the U_3O_8 in the ore, the following relation holds:

1 kg U_3O_8 cofresponds to 0.8481 X 0.33 = 0.279873 mg radium.

Example:

a) 4000 kg dry ore, according to chemical analysis, contain 50% of U_3O_8; the uranium and radium contents are to be determined:

$4000 \times 0.50 = 2000$ kg U_3O_8

$2000 \times 0.8481 = 1696.2$ kg U

$1696.2 \times 0.33 = 559.746$ mg Ra

b) The radium content of the above material is to be determined directly from the U_3O_8:

$4000 \times 0.50 = 2000$ kg U_3O_8

$2000 \times 0.279873 = 559.746$ mg Ra.

SECRET

Report of the Freiberg Mining Office on the Technical Execution of the Operations and Investment Plans approved by the Ministry of Economics for the Fiscal Year 1940 of the "St.Joachimsthaler Bergbau-Gesellschaft M.b.H."

I. Production of crude ore, throughput of processing plant, ~~xxx~~ shipment of processed ore:

1) The production of crude ore of the St. Joachimsthaler Bergbau-Gesellschaft, according to data supplied by the management, was as follows, in the period between 1 April 1940 to 31 March 1941:

100.0095 tons of crude ore (wet)

with an oxide content of 7.789 tons of U_3O_8

" a metal content of 2180.920 mg Ra

corresponding to a content of approx. 7.8% U_3O_8

The production quota of 95.525 t has been filled to 104.7 %.

2) The throughput of processed ore in the fiscal 1940, including the remainder of 2.0185 tons ⊄ , amounted to:

102.028 tons of crude ore (wet)

with an oxide content of 7.9462 tons of U_3O_8

and a metal content of 2224.936 mg Ra,

corresponding to an oxide content of approx. 7.8% U_3O_8.

The production of processed ore (concentrate) was:

12.68709 tons dry, with 55.115 % U_3O_8

corresponding to an oxide content of 6.99248 tons U_3O_8

and a metal content of ~~2224.936 mg Ra~~ 5.930207 tons U

or 1956.902 mg Ra.

The processing yield for the fiscal year 1940 is thus 88%.

3) The shipments of processed ore in the fiscal year 1940 amounted to:

Consignee	Processed ore, dry, in tons	U_3O_8 content, in tons	Metal content U, in tons	Metal content Ra, in mg
Auer, Berlin	3.97896	2.23211	1.893060	624.713
Buchler, Braunschweig	4.64153	2.51500	2.132840	703.783
Chem. Works Treibach	4.06660	2.24537	1.904307	628.406
Total:	12.68709	6.99248	5.930207	1956.902

SECRET

The production quota for 1940 of 1800 mg of radium has thus been ~~xxxx~~ fulfilled by 188.7 %.

On 31 March 1941, there were no reserves of crude ore on hand.

II. Investments on the basis of government-backed credits (so-called " large investments")

Of the ~~xxxxxxxxx~~ government-backed loan of 1,1[illegible],000 RM by the Kreditanstalt der Deutschen at Reichenberg to the St. Joachimsthaler Bergbau Gesellschaft, made on 21 Sep 1939, an expenditure of 546,000 RM was planned for the fiscal year of 1940. These expenditures were distributed as follows:

1) Development work underground	399,000 RM
2) Construction work on processing plant (flotation)	2,000 RM
3) Buildings and construction work	48,000 RM
4) Machines and equipment	97,000 RM
	546,000 RM.

Appendices 4a, 4b, and 4c show the planned expenditures from this loan, and the actual expenditures as compiled by the accounting department. Appendices 6,7,8, and 9, showing diagrams of the mines, have the individual projects specially marked.

A summary of the planned and actual expenditures shows the following:

	Planned expenditures in RM	actual
1) Prospecting	~~[illegible]~~	
Werner shaft	163,700	144,763.19
Einigkeit shaft	97,200	96,203.92
Edelleut tunnel	138,100	115,467.45
Total prospecting expenditures	399,000	356,434.56
2) Processing	2,000	2,264.90
3) Contruction work	48,000	36,259.04
4) Machinery	97,000	58,349.46
Total	546,000	453,307.96
Appraisal of the ores mined during prospecting operations:		- 29,514.75
		423,793.21

The fact that the actual expenditures were lower than the planned ones can be explained as follows: The lower expenditures for prospecting are ~~xx~~ partially due to the fact that the Werner shaft was out of operation for two months because of

SECRET

water difficulties, and partially due to lack of manpower. The planned extending of underground installations, in meters of length, was fulfilled only by 98%, while the expenditures were only 89%, and if the value of the ore mined during the work is included, only 82% of the planned figure.

A great reduction of expenditures in the construction projects was caused by the fact that the planned immersion plant could not be completed during this fiscal year. The labor shortage caused some of the sawmill installations to remain unfinished. The rebuilding of the repair shop of the Werner shaft, which was not carried out, can be certified as essential work.

A number of planned expenditures for machinery were not made, since the machines which had been ordered did not arrive. Still oustanding are, primarily, cables and one centrifugal pump. The additional purchases 1 m, 1 n, 1 o, 2 h, 2 i, 2 k, 2 l, 3 m and 3 n , which were not planned, can be certified as essential. Since these purchases will not cause the expenditures to exceed the planned level, we recommend approval of these purchases.

The prospecting work and the construction work were carried out properly.

B. Continuous investments , written off against interest

Appendix 5 shows the individual projects listed in the explanatory remarks of appendix 3/40 Pos. I d, in comparison with actually performed projects. The mine maps show the individual projects specially marked.

A summary of a comparison between planned and actual performance and cost shows the following:

	Planned		Actual	
	advance of face in m	costs in RM	advance of face in m	costs in RM
1. Werner shaft	316	69,400	329.3	59,278.72
2. Einigkeit shaft	190	41,400	195.6	43,218.36
3. Edelleut tunnel	80-90	20,700	125.3	25,305.53
	586-596	131,500	650.2	127,802.61
Appraisal of the ores mined during operation				- 62,750.25
				65,052.36

The length of shafts and tunnels dug exceeded the planned figure by about 10%, while the actual costs were only 97 % of the planned figure, and only 49.5%, if the value of the ore mined during the operation is included.

The

SECRET

The costs per meter of digging (including overhead stopes) were 196.5 RM, not including the deduction for the value of the ore mined.

The work has been carried out properly. It is recommended that projects 1 g, 3 b, 3 c, and 3 d be approved.

Freiberg, Saxony, 30 October 1941.

Appendices:

1) Production of crude ore (missing) -

2) Processing throughput and concentrate production

3) Shipments of concentrate

4) a,b,c) Investments from government-backed credits

5) Continuous investments , written off against interest

6) Cut of the Werner shaft, scale 1:500 (missing

7) Cut of shaft sinking operations, Werner shaft , scale 1:200 (missing)

8) Cut of Einigkeit shaft, scale 1:500 (missing)

9) Cut of Edelleut tunnel, scale 1: 500 (missing).

SECRET

Dup

URANIUM ORES IN THE REGION OF THE FREIBERG MINING OFFICE

A) Pitchblende ores:

1) Johanngeorgenstadt:

Some of the veins of the Eastern part of the mining region, in the department "Frisch Glueck" of the "Vereinigt Feld" mine in the Festenberg mountain at Johanngeorgenstadt contain uranium pitchblende ores. They were found in the veins "Georg Wegfort", "Segen Gottes", and "Neugeboren Kindlein". The "Segen Gottes" vein yielded 20.2 tons of uranium ore until 1920, equal to 1.4 tons of uranium.

In 1936 -37m , a gallery was built on the 78 Lachter level (Note: Lachter: old German miners' unit of measurement of length, approx. 2 meters) to investigate these veins. It struck the "Neugeboren Kindlein" vein and the "Georg Wegsfort" vein and found them to be pitchblende-bearing. In 1938, a parallel strike from East to West was made on the "Neugeboren Kindlein" vein. Toward the East, the extraordinarily rich ore content of the vein disappeared after about 30 m. Traces of ore were found toward the West along a stretch of about 50 m. The "Georg Wegsfort" vein was investigated in 1939 only along a short distance. A 4m deep pit was dug in a spot at which the ore was concentrated, and during the same year, a 9 m high overhand stope was dug in a portion of the vein, which was also relatively rich in ore. These operations opened up about 30 sq. m of the area of the vein and yielded ~~xxxxx~~ 250 kg of ore, containing a total of 38.9 kg of uranium oxide. The yield of the veins thus was ~~approxi~~, on the average, 1.3 kg of uranium oxide per sq. meter, in the portion where mining operations were carried out. Due to the method of mining employed, the losses were considerable, so that the actual ore content at this spot probably was much higher. The veins usually had a depth of 1 to 2 cm, maximally of 10 cm. The pitchblende was found here, similar to that in the offshoots of the "Glueckauf" vein at Joachimsthal, without any associate mineral in the vein. Where-ever such a mineral is present, it is of the quartz type. In relation to the depth of the veins in these only slightly mined vein portions, which are definitely concentrations of rich ores, the average content was 2.6% uranium oxid e. Computed on the basis of a vein width whihh can be mined, including the neighboring rocks, the content should be 0.2 %.

Since the mine receives a government subsidy only for its bismuth production, the prospecting work for uranium had to be suspended.

Dup

As comparison, we quote some figures from Joachimsthal:

The "Schweizer" vein, during the last few years, has been yielding 1.1 kg of uranium oxide per sq. m in its mined portion. Computed on the basis of the total depth of the vein, including the many interspersed shale portions of the composite vein, this amounts to a total yield in the mined portion of 0.04 % uranium oxide.

The "Bergkittler" vein yielded 1.2 kg of uranium oxide per sq. m, and an average content of the total vein of 0.5 %.

The "Geister" vein yielded 0.6 kg per sq. m, and 0.1% uranium oxide, computed on the basis of the depth of the vein.

The other sections of the Johanngeorgenstadt mine, including the neighboring rocks, do not bear any uranium.

2) Schneeberg.

Despite the high emanation content of the air from the mine, uranium ores at Schneeberg appear only as mineralogical oddities. The neighboring rocks of the bismuth veins also contains practically no uranium.

3) Margarete nr. Breitenbrunn.

A magnetite-bearing skarn deposit is penetrated by offshoots of veins of the bismuth-cobalt-nickel formation. Within the magnetite-bearing skarn, pitchblende is occasionally found as a mineralogical oddity.

4) Uranium pitchblende is also occasionally found as a mineralogical oddity in the "Himmelfahrt" and "Himmelsfuerst" mines at Freiberg, and in the "Himmlisch Heer" mine at Annaberg.

B. Autunite and torbenite ores.

The "Himmelfahrt" mine at the Milchschachen near Steinbach nr. Johanngeorgenstadt contains autunite ores in a secondary offshoot of the "Michael" vein, a vein bearing oxidic bismuth ores. A few tons of material with a uranium oxide content of approximately 0.5 to 1% have been mined there. This deposit is also practically of no importance, since, as the mining for bismuth there has shown, the autunite deposit does not extend along a sufficiently long stretch.

Freiberg, 15 September 1945.

BISMUTH MINING IN THE DISTRICT OF THE FREIBERG MINING OFFICE

A) General

In the Mining Office District of Freiberg, bismuth is mined in two categories:

1) Mining in veins which contain bismuth ores in addition to cobalt, nickel and uranium ores.

2) As by-product of tin-wolfram mining.

These are mainly large massive greisen deposits, which , in addition to containing cassiterite, also have a considerable content of bismuth which, depending on the method of ore dressing employed, is either obtained as a separate concentrate, or processed together with the tin and then obtained as a byproduct in the refining of the tin.

In 1943, in a total mining production of bismuth of 26.2 tons a quantity of 9.7 tons or 37% were obtained as a byproduct of the tin-wolfram mining operations. In 1944, the total production of bismuth was 24.8 tons, of this 11.3 tons or 41.5% from tin- wolfram mining. After the completion of the ore dressing plant at Sadisdorf, the bismuth production was to be about 50 tons, with 36 tons or 72% of it to be provided by the tin-wolfram deposits. The tables below show the production of the individual mines in 1943 and 1944.

Pure Bismuth mining	1943	1944
1) Schneeberg	9.5 tons	4.5 tons
2) "Vereinigt Feld" mine, Fastenberg Mt. nr. Johanngeorgenstadt	7.0 tons	9.6 tons
Tin-Wolfram mining		
3) Zwitterstock, Altenberg	6.7 tons	5.9 tons
4) Tannenberg	1.0 tons	1.3 tons
5) Zschorlau	2.0 tons	3.5 tons
Total :	26.2 tons	24.8 tons

Below are the details on the individual mines:

B) Mining of bismuth only

I. "Vereinigt Feld " mine, Fastenberg Mt. near Johanngeorgenstadt

1) Geological summary

SECRET

The Johanngeorgenstadt region is a ditch-like depression, formed by two large faults, in the marginal region of the Eibenstock granite. Parts of the shale

Dup

mountains which lie over the edge of the Eibenstock granite are contained in this area. The surface in the vicinity of Johanngeorgenstadt contains phyllite, or the conversion products obtained from their contact metamorphosis, such as mottled shale, knotted shale, fruchtschiefer, and andalusite shale and hornblende. As mining has shown, there is a granite layer underneath this shale complex. It contains fissure systems of different ages. The oldest ones of these, judging from the nature of the vein fissure, are probably of the same age as the marginal faults of this ditch. They are older than the ore veins known in the Johanngeorgenstadt region. They are formed by great strata of totally broken rocks. They do not contain ores of hypo- to mesothermal granitic origin. These breccia zones which can be followed for a length of many kilometers carry only in spots a slight mineralization of the epithermal, non-magmatic iron-manganese ore formation, which has never been mined to any great extent in the Johanngeorgenstadt region itself. However, along the marginal fissures of the Johanngeorgenstadt ditch, a very active mining for hematite has been carried out from time to time. In the Southeast part of the ditch these veins trend from Northeast to Southwest. In the Northwestern part they turn to a NNW-SSE direction. The bismuth ore veins proper are veins trending from East to West, Northwest to Southeast, and Northeast to Southwest. They are more recent than the breccia layers, are interrupted by the latter and sometimes resume beyond these breccia layers as workable veins.

The vein fissures of the Johanngeorgenstadt region have the peculiar characteristic of having been torn and moved after first having forme . Thus the same fissure will contain completely different mineral parageneses. The first vein filling was pneumatolytic, consisting of parageneses of the cassiterite formation, mostly cassiterite and quartz. The cassiterite was present only at the higher levels, giving rise to a small production in the first days of mining in the region. At lower levels, only pneumatolytic quartz is found, so-called "wild quartz", which often develops and accompanies the bismuth-containing veins.

The next formation, which occurs in isolated spots in the vein fissures which were torn again, is the hypothermal, silicified lead ore formation, containing galena, zincblende, and pyrite.

The most common deposits in the fissure system are the mesothermal deposits

Dup

of the bismuth- cobalt - nickel formation, predominantly with bismuth in the native state and with small amounts of associated ores of the rammelsbergite-safflorite group and in the upper levels with silver in its native state, argentite, and red silver ore as the primary products.

The Eastern part of the mining region, in the department "Frisch Glueck", uranium pitchblende ores are found in some veins, sometimes in workable quantities. They are found especially in the "Segen Gottes" and the "Neugeboren Kindlein" veins.

Until 1920, the "Segen Gottes" veins had yielded 20.2 tons of uranium ore, containing 1.4 tons of uranium oxide.

In 1936/37 a gallery was built to prospect in the veins on the 78-Lachter level. It struck the "Neugeboren Kindlein" and the "Georg Wagsfort" veins about 165 m below the previous strikes, and found them to be ore-carrying at that point.

A strike was made in 1938 on the former, trending in an East-West direction. In the East the vein became totally dead after 30 m, after having been rich in ore in all other points. Traces of pitchblende occurred to the West along a stretch of about 50 m.

The latter was investigated during the following year along a short stretch. A sump, 4 m deep, was sunk in one point of ore concentration, and a 9 m high over-head stope dug in the " Neugeboren Kindlein " vein, also during 1939. These operations uncovered approximately 30 sq. m of vein area, which yielded 250 kg of ore. The uranium oxide content of these ores was 38.9 kg.

Thus, in the worked portion, the veins had an average yield of 1.3 kg uranium oxide per sq. m. With the mining method used, the losses were considerable, and the actual yield as obtained at the face was probably a good deal higher than the above figure. It should be approximately the same as the yield of the middle level veins at Joachimsthal.

The thickness of these veins is 1 to 2, maximally 10 cm. The pitchblende here, similar to the offshoots of the "Glueckauf" vein at Joachimsthal, usually occurs without associated minerals. Whenever there is one, it is either quartz or spar (brown spar).

As compared to the thickness of these only slighly worked points, definitely contentrations of rich ores, the average content was 0.6 % uranium oxide. When

Dup

computed on the basis of a workable width, including the neighboring rocks, the content would be approximately 0.2% uranium oxide.

Since the mine receives state subsidies only for its bismuth production, the uranium prospecting had to be suspended without having reached a conclusive result. The work along these lines which was carried out does not even remotely satisfy the requirements for a thorough investigation. First of all, the distance between the levels is too great for the probably highly staggered mineralization (158 m, resp. 184 m), and besides the strike tunnels were too short and tunnels driven on the rise were ~~xxx~~ hardly built at all. The results of the investigations carried out so far do therefore not permit the conclusion that the Johanngeorgenstadt veins are of no interest whatsoever as far as uranium is concerned.

With a striking length of the probably uranium-containing ~~xxxx~~ parts of the three veins of 600 m total and a workability coefficient of 0.05 the potential quantity of uranium oxide contained in these veins can be estimated at approximately 80 to 90 tons. Since the ore-carrying minerals are strongly staggered, the costs of mining the ore will be high, however.

Movements in these fissures, at a later date, perhaps in connection with the occurrence of the marginal fault of the Southern Ore Mountains, ~~xxxxxxxxxxx~~ tore up the vein filling considerably. Therefore, the vein fissures often have the form of fault fissures, especially so in the granite-shale contact, where one vein wall will be contact shale, the other one granite.

A change in the kind of ore contained by the veins in granite could not be observed anywhere. The granite contains ore just as good as the shale.

The best example for this is given by the department "Himmelfahrt" at Milch-schachten near Steinbach. This mine is located at the extreme Western end of the Johanngeorgenstadt mining region, complete within the granite zone.

At a 60 m long intersection of two offshoots whose outcropping carries mineral parageneses of the pneumatolytical tin formation, there is a rich deposit of bismuth ocher ore. This deposit was detected to extend to 150 m below the outcropping and most of it has been mined by now. Outside of the intersection, the two offshoots are not workable. The deposit has yielded approximately 60 tons of bismuth ~~xxxxxx~~ up to now.

~~Thexxxx~~

1 Dup

The vein is well developed below this ore deposit, but it contains only quarz and traces of ore every now and then. These traces are not workable. In the prospecting work, the non-workable root of this small deposit seems to have been reached.

A secondary offshoot of this vein, called "Michael", which was uncovered in the course of mining the vein, autunite ores were found. Unfortunately, they turned out to constitute only a local deposit which became exhausted very quickly. The reason for this occurrence is probably the oxidation of an isolated concentration of pitchblende ore. In general, the bismuth ores of the "Himmelfahrt" mine contain no uranium. Some autunite ores with a uranium oxide content of approximately 0.5 to 1% were mined and unloaded separately on the dump. Considering the fact that it is planned to open up the torbenite deposit of Schoenficht in the Kaiserwald, flotation experiments were performed with this material. They were practically without success. According to the processes employed up to now, it will probably be more economical to use a leaching method for ores of this type.

In the Johanngeorgenstadt region, the oxidation zone reaches down to an extremely great depth, so that the oxidation products of bismuth, bismuth ocher and others, are the main ores to be found underneath the silver zone. Bismuth cores within the bismuth ocher are found only occasionally. Vein offshoots which were not affected by the later movements of the great vein fissures, still carry primary ores at depths where only secondary ores are found in the main fissures.

This strong movement which took place after the bismuth ores had been deposited causes the vein filling in the main veins, which had been a primary deposit, to be badly disrupted and pulled apart. On the other hand, this means that the Johanngeorgenstadt region which has so far been developed only to slight depths from the point of the geology of the deposits, because mining usually was halted when broken portions of veins were struck, that ores can possibly be found beneath these broken veins, as is also the case at Joachimsthal. There, rich bismuth ores are found underneath a broken zone of approx. 200 m depth.

2) Operational data

SECRET

a) Methods of development

The mining in Johanngeorgenstadt has been going on for centuries, and the con-

Declassified in Part - Sanitized Copy Approved for Release 2012/04/04 : CIA-RDP82-00039R000100060052-8

ditions in the individual mines and veins have been recorded in writing and are on file in the archives of the Mining Office. Therefore, the development of new vein portions in this area is carried out by first determining the probability of strikes in individual veins or portions of these veins by looking through the records on file. Then, according to the data contained in these files, the work is carried out by reopening of old workings or by building of new ones. This is important, because the mines used to produce primarily silver in the old days. At that time, veins containing little silver, but bismuth ores instead, were not worked. Thus portions of the mines which had been worked years ago and had been considered exhausted have now yielded considerable amounts of bismuth ores.

b) Ore reserves

The definite, probable, and possible ore reserves are shown in the appended table. The total reserves, according to this compilation, amount to approximately 50,000 tons of ore with a content of 120 tons of bismuth.

Approximately 45 tons of this represent possible ore reserves down to an average depth of 225 m. For mining of these ores, considerable expenses for the extending of shafts, construction of new workings, etc. will be required.

c) Methods of mining, haulage, ventilation, water conditions.

Mining is carried out exclusively by overhand stoping, with the stopes generally being left untimbered. Timbering is used only in badly broken portions of the vein. Associated rocks and vein are blasted separately. The especially rich portions, containing 8 to 12% bismuth are removed from the rubble and hauled separately. This rich ore is dry-ground at Johanngeorgenstadt and then sold to the refining plant without further dressing operations. The poorer ores are hauled to the hauling level on rollers, brought to the main shaft and then conveyed to the surface. Part of the hauling operations is performed by a battery-driven mine locomotive.

The main shaft, as well as the second conveyor shaft in the Vorderer Fastenberg mountain and the "Frisch Glueck" shaft (a blind shaft) are inclined. Conveying is carried out by means of dump buckets.

The ore is brought from the main shaft to Schneeberg for processing by truck.

The main ventilation current is generated in tunnels and shafts utilizing the natural draft. Blind tunnels have special ventilation, generated by compressed-air ventilators. The air in the mine is constantly checked for its content of radium emanation.

SECRET

Normal seepage is slight. It amounts to 0.5 to 0.8 cubic cm per minute. Continuous rain and rapid melting of snow while the ground is not frozen can increase this figure to a multiple, because of the wide area covered by the mine.

d) Crude ore production and contents

The production of inferior ore in 1943 and 1944 is shown in the table below:

1943	1944	1943 % of Bi yielded	1944 % of Bi yielded
2,238	1,092	0.19	0.70

The great increase in the bismuth content of the crude ore in 1944 is due to the fact that the Schneeberg mine was partially flooded. For making up the loss of production caused thereby, the administration of the mine had the production of bismuth from the rich vein portions of the department "Himmelfahrt" increased.

e) Dressing processes

The ores are subjected to the usual oxide flotation at Schneeberg. The appended flow sheet shows the details of the process.

f) Production of concentrate	1943	1944
Concentrate in tons	291.94	394.23
Bismuth content in %	15	19.5
Bismuth content in tons	4.36 dry	7.66 dry
Bismuth content of rich ores in tons	2.64	1.94
Total production	7.00	9.60

g) Efficiency

The average output of metal per shift of the total crew was 0.29 kg in 1943 and 0.35 kg in 1944.

II. Cobalt mining at Schneeberg

1) Geological summary

The cobalt mining region of Schneeberg is located at the Northwest edge of the Eibenstock granite massif, between the Eibenstock granite and the Aue granite. At this point, there is a depression in the surface of the granite, with a steep Soutwest flank and a fairly flat Northeast flank. This depression contains a number of veins, some of them extending for several kilometers in length. All those which

SECRET

are workable trend from Southeast to Northwest. The dip varies. The associated rocks of the veins, in the vicinity of the granites, is contact-metamorphous phyllite, in the central part at upper levels it is unchanged phyllite. At greater depth, both at the Northeastern as well as at the Southwestern end of the region, granit was struck. Mining in these portions of the region w as carried out in the granite and in the shale which encases it. The veins do not change when they go from granite into shale. A few of them go dead in the shale toward greater depths, others continue to carry rich ore all the way into the granite rock.

This system of veins is intersected by veins trending from Northeast to Southwest, but these veins carry no ore and have been used for a long time only as direction markers for lateral galleries.

The ore content of the Schneeberg veins whose thickness varies from fissure width to 1 m consists mainly of bismuth in its native state, smaltite, and minerals of the rammelsbergite-safflorite group, which, combined with each other are known in this region as "mixed cobalt". In all cases the bismuth predominates. In the oxidation zone it has everywhere been turned into bismuth ocher. The sulfides, resp. arsenides caused the formation of en extremely great number of partially unique minerals which occur only at Schneeberg.

Although the emanation content of the mine air is considerable, uranium ores are rather rare at Schneeberg and are of only mineralogical significance.

Similar to Joachimsthal and Johanngeorgenstadt, the veins carry rich silver ores(silver in its native state, argentite, red silver ore, cerargyrite), at the higher levels. The silver content of the veins is a primary variation in depth and quickly disappears toward lower levels..At the levels being worked at the present time the silver content of the ores, and thus the silver production of the Schneeberg mines, are extremely small. In 1943 the silver production was only 4 kg. At some points, the veins were traced down to considerable depths, approx. 400 m. This showed that the mineralization in the central part of the region, independent of the associated rocks, reaches greater depths than in the marginal zones.

SECRET

While ores can still expected to be found at greater depths in the central part of the region, most veins in the marginal zone have been prospected all the way to their dead roots. The Schneeberg mining operations, therefore, will be restricted in the future, as it has been for the past few years, to working of the old remnants of veins which have been left unworked, and to the prospecting and working of a few veins in the central portion.

2) Operational data

a) Prospecting methods

As everywhere in the Saxonian Ore Mountains, where old mines are present whose conditions have been recorded in writing, Therefore, the prospecting of new parts of veins is first carried out by studying of the written data on file, to determine the probable yield. This is usually a very successful method, because the object of mining, in the course of centuries, has constantly changed. At first the mining was primarily for silver ores, then for cobalt ores, while now the bismuth ores are the primary object of mining. Since the reports contain a general description of the ore contents of the veins, the files will yield valuable information on the ore content of vein portions which were of no interest to our predecessors. After vein portions have been established as probably ore-containing, the area to be mined is opened up by building new shafts or reopening old ones from one of the existing levels, and then prospected by building stopes or strikes, and then worked.

b) Ore reserves

The probable ore contents are shown in the appended table.

c) Methods of mining, hauling, ventilation, and water removal.

The working methods employed are overhand stopes and building of inclined tunnels. The former method has the advantage of being more adaptable, as regards irregular form of ore-bearing strata. The latter is more efficient and more economical. Therefore, it is preferred, whereever an ore vein is already well known and where there is little chance that the vein will go dead within the strike area. In both methods, vein and associated rocks are blasted separately, whenever possible, and coarse rubble blasted in with the vein is carefully kept back in the mine.Sections of rich ore, with an average content of approximately 10% Bi-Co-Ni are also kept separate and hauled separately as rich ore. The hauling of the poor ores is carried out by means of vertical chutes and from higher levels by means of tip chutes to the main haulage level (110 Lachter). From there the ore is hauled, either manually or by battery-driven mine locomotive, to the haulage shaft, the "Weisser Hirsch" shaft. The ore is brought to the surface from

SECRET

this inclined shaft by means of a conveyor bucket. The excess dead heaps are hauled in the same manner to the "Neujahr" shaft and hauled to the surface in this inclined shaft. It had been planned for future operations to develop the only vertical shaft of the mine, the "Beust" shaft, as the main haulage shaft, and also to move the main ore dressing plant to this location, because the latter is now located at the "Weisser Hirsch" shaft, where the facilities for dumping dead heaps afe within the city limitx of Schneeberg-Neustaedtel and will be completely filled within a few years.

The main ventilation current utilizes the natural draft which blows through the various shafts. Blind shafts are ventilated by compressed-air fans. The water on the lowest level, whose accumulation varies with precipitation (3 to 4 cu. m per minutem, and above), is brought up to the level of the "Marx Semmler" tunnel at the central pumping stations at the "Beust" shaft and the "Weisser Hirsch" shaft, The "Max Semmler" tunnel, driven from the valley of the Zwickauer Mulde river, has a length of about 20 km, including its branches.

d) Production of crude ore

~~1943x~~	crude ore, in tons,	bismuth content %	Co and Ni, %
1943	5,887	0.20	0.12
1944	2,323	0.20	0.12

The lower production in 1944 can be explained by the fact that the sudden melting of the snow in the spring of 1944 caused to inflow of water to exceed the capacity of the pumps so that the mine became flodded. It took several mpnths to pump it dry again.

e) Processing

Both arsenidic and oxidic ores are treated by flotation in separate systems. The flow sheet for the processing is appended. In addition to the ores mined at Schneeberg, the oxidic ores from Johanngeorgenstadt are also processed here.

~~f) Production of concentrate~~

SECRET

f) Production of concentrate

	1943	1944
oxidic concentrates, tons	25.91	4.34
Bismuth content, %	24.1	26.8
Bismuth content, tons	5.55	1.16
Arsenidic concentrates, tons	78.00	58.83
Bismuth content, %	5.2	5.7
Bismuth content, tons	4.07	3.32
Cobalt content, %	2.1	3.6
Nickel content, %	0.8	
Cobalt content, tons	1.63	2.08
Nickel content, tons	0.58	

g) Efficiency

The average output of metal per shift of the total crew was 0.118 kg in 1943 and 0.08 kg in 1944. The reduced efficiency in 1944 is due to the performing all kinds of auxiliary operations necessitated by the flooding of the mine.

IIII "Segen Gottes" mine near Antonstuhl

1) Geological summary

South of the village of Antonsthal near Schwarzenberg, on the ridge between the Schwarzwasser and the Poehla rivers, tin ores veins occur, which were worked once. On one of the deap heaps of this old tin mine, bismuth ocher ores were found, which have already previously given the impetus to prospecting for bismuth ores. This prospecting work led to the strike of a bismuth ore vein of a depth of 10 to 50 cm and a length of approximately 250 m. The last 80 m of this vein run along a quartz lense which also contains bismuth-carrying offshoots. Processing tests of the vein worked during these prospecting operations showed an average content of the vien of approximately 0.2% bismuth. On the basis of an average thickness of the vein of 30 cm, a yield of bismuth of 1.5 kg per sq. m of vein surface mined can be expected. With the strike length of the mine known so far - the vein is still ore-bearing at the face - a deposit density of approximately 375 kg Bismuth per m of vertical depth can be computed.

SECRET

This strong movement which took place after the bismuth ores had been deposited causes the vein filling in the main veins, which had been a primary deposit, to be badly disrupted and pulled apart. On the other hand, this means that the Johanngeorgenstadt region which has so far been developed only to slight depths from the point of the geology of the deposits, because mining usually was halted when broken portions of veins were struck, that ores can possibly be found beneath these broken veins, as is also the case at Joachimsthal. There, rich bismuth ores are found underneath a broken zone of approx. 200 m depth. proximately 0.5 to 1% were mined and unloaded separately on the dump. Considering the fact that it is planned to open up the torbenite deposit of Schoenficht in the Kaiserwalt, flotation experiments were performed with this material. They were practically without success. According to the processes employed up to now, it will probably be more economical to use a leaching method for ores of this type.

In the Johanngeorgenstadt region, the oxidation zone reaches down to an extremely great depth, so that the oxidation products of bismuth, bismuth ocher and others, are the main ores to be found underneath the silver zone. Bismuth cores within the bismuth ocher are found only occasionally. Vein offshoots which were not affected by the later movements of the great vein fissures, still carry primary ores at depths where only secondary ores are found in the main fissures.

9

The mine is located about 1 km Northeast of the Eibenstock railroad station in the Ore Mts. at the bank of the Zwickauer Mulde river. The Northernmost offshoot of the highly contact-metamorphous cover blocks of the Karlsbad granite massif, which have their greatest extent on the Auersberg mt., descends here as far as the Mulde valley. The granite and the contact shale, at this point, contain a number of tin ore veins which used to be worked formerly. One of these

SECRET

tin ore veins was laid open within the shale by means of a tunnel. The Eastern contact between the granite and the shale is formed by a fault which is filled by a ferrilith vein. East of this ferrilith vein the tunnel struck a quartz vein trending from East to West and almost vertical . This vein was intersected at an acute angle by an offshoot bearing bismuth ocher. About 290 m from the tunnel entrance, a shaft to the surface has been dug. The vein, at a level of about 20 m, consisted of probably pneumatolytical quartz of a thickness of 30 to 50 cm, bearing no ore. Its sill and its roof alternately carried small offshoots of quartz in decomposed granite, bearing bismuth ocher. At the bottom of the tunnel, at the shaft face, the vein was still in existence and reportedly contained comparatively great amounts of bismuth ocher. The conditions here thus resemble those prevailing in the "Himmelfahrt" mine. Here, too, a vein originally belonging to the pneumatolytical tin ore formation was joined by a second fissure which ran jointly with the tin ore vein in the same fissure. Within the junction zone the vein was rich in bismuth ocher.

The analogy of the geological conditions permits the conclusion that it will be possible to develop a small bismuth ore mine at this location, similar to the one in the "Himmelfahrt" region at Milchschachen near Steinbach,

The ores of the "Himmelfahrt" mine at Milchschachen near Steinbach will soon be completely exhausted. Therefore the mining office has recommended to the "Sachsenerz A.G."to use the machinery from the "Himmelfahrt" mine for prospecting operations in the "Christi Himmelfahrt" mine on the Gerstenberg Mountain near Muldenhammer.

Since the "Himmelfahrt" mine at Milchschachen will soon be exhausted, it would be advisable to start the preliminary work for the opening ofthe "Himmelfahrt" mine at the Gerstenberg mountain as soon as possible. The quantity of bismuth which can be mined here should be about 50 to 60 tons of bismuth, about the same as in the other smaller deposits at the edge of and within the Eibenstock granite stock, such as the "Himmelfahrt" mine at Milchschachen and the "Gottes Segen" mine at Antonsthal.

C) Bismuth as by-product in mining of tin and wolfram

I. Zwitterstock, Altenberg

SECRET

C) Bismuth as by-product of tin-wolfram mining

I) Altenberg "zwitter" (greisen) massif

1) Geological summary

Immediately at the East edge of the city of Altenberg in the Eastern part of the Ore Mountains, a great fissure, filled by quartz porphyry and granite porphyry, is topped by a steep, small, and comparatively recent (probably Lower Permian) granite hill.

The top of this granite hill has been turned almost completely autometamorphously to a greisen which carries mica and topaz and which is rich in cassiterite, the so-called "zwitter". In addition to cassiterite, this greisen contains small amounts of wolframite, bismuth in its native state, and hematite and fluorite. This greisen block was the object of an extensive cave mining centuries ago, but the weakening of the rock pillars between the individual caves finally caused the workings to collapse. Thus a sink, 70 m in depth, formed at the surface, and an extensive area of broken rocks at lower levels, consisting mostly of cassiterite-bearing zwitter. This rubble has been mined for centuries. More recent investigations have shown that at the margin between the broken area and the unchanged granite there are still considerable quantities of zwitter to be found which might also be workable.

2) Operational data

a) Methods of prospecting

Real prospecting work in the form of an investigation of the deposit have been carried out not only in recent times. A circular tunnel was started on the lower level, to run approximately at the boundary line between unchanged granite and zwitter. Stubs into the center of the zwitter mass were to determine the extent of the broken area, and also to establish the thickness of the zwitter mass which is still intact and to find out its ore contents. Similar work was carried out along the edges of the broken area which becomes narrower in diameter at increasing depths.

b) Ore reserves

These prospecting projects made it possible to determine to some extent the form of the broken area between the tunnel level and the main haulage level 60 m below it, thus giving an idea of the extent of the broken rocks still at the site.

SECRET

Declassified in Part - Sanitized Copy Approved for Release 2012/04/04 : CIA-RDP82-00039R000100060052-8

The reserves are approximately as follows:

	millions of tons	% Sn	tons of Sn	gr/ton Bi	tons of Bi
Broken rock	5 - 8	0.25	12,000 - 20,000	41	200- 300
	1.5	0.50	7,500	90	144
Solid rock	0.6	0.50	3,000	90	54
	7.1 -10.1		22,500-30,500		400 - 530

c) Methods of mining, haulage, ventilation and water removal

The mining is carried out, similar to the method employed in mining of blocks~~xxxxx~~, by moving the rubble across a grate through which they fall into storage bins. From these the ore is removed to the haulage level and~~xxx~~ hauled to the pre-crusher installation near the shaft on the haulage level by means of battery-driven mine locomotives. There the rocks are dumped into a crusher by means of a rotary tipper, from there run into a storage bin and loaded into carts on the haulage level of the shaft 40 m below and then hauled to the surface.

According to the peculiarities of the Altenberg rubble mining which takes advantage of the presence of natural rubble in contrast to block mining and due to the fact that the foundation upon which the rubble lies has an irregular surface, the hauling station are irregularly distributed. Some of them are at the edge of the rubble area, and in some places the rubble area is struck only at greater height above the level containing the grate in overhand stopes, and the rubble brought down to the grate through the stopes. The breaking up of ~~xx~~ larger rocks on the great is done by hand. Medium-sized blocks are broken mechanically, and big ones are drilled and blasted.

Fresh air is circulated both through the shaft and through the rubble. The natural draft is aided by a ventilator in the mine. Blind tunnels are ventilated by compressed-air fans.

The seepage of water amounts to an average of 2 cu.m per minute.

d) Crude ore production and contents

	1943	1944
tons of crude ore	109,742	74,989
% of Sn	0.51	0.51

SECRET

The lower production during 1944 is explained by the fact, that operations at the mine were suspended for 2½ months. The crew of the mine had to be used for the construction of the foundations for a new dump heap for the dressing plant, because the parts for the sludge pumps which used to pump the waste from the dressing plant into a surface mine across the Ore mountains near Teplitz could no longer be obtained because of the war.

e) Dressing method

Part of the mined rocks, approximately 60 tons per day, is processed in a conventional wet mechanical washing plant (crusher and buddle). Most of the rock is hauled by cable railway to the flotation plant at the bank of the Schwarzwasser, where 10 to 12% concentrates are made by flotation. These concentrates are volatilized in the rolling plant at Freiberg by way of tin sulfide and then concentrated to a product which can be refined in a reverberatory furnace.

f) Production of concentrate

	1943	1944
Concentrate, tons	3,149	2,354.20
Sn content, %	11.3	10.5
Sn content, tons	364.14	247.82
Bi content, %	0.21	0.25
Bi content, tons	6.68	5.90

g) Efficiency

The average output of metal per shift of the total crew was

	1943	1944
Sn, kg	4.27	2.86
Bi, kg	0.07	0.067

The drop in efficiency in 1944 is due to the suspension of operations for 2½ months (see above).

II. Copper mine Sadisdorf near Schmiedeberg

1) Geological summary

SECRET

II. Tin Copper mine Sadisdorf near Schmiedeberg

1) Geological summary

East of the town of Schmiedeberg near Altenberg in the Eastern Ore Mts, the gneiss contains a small, steep peak of tin-bearing granite. The center of this tin-bearing granite mass has been converted autometasomatically into a tube-shaped, dark, fine-grained greisen containing mica, topaz and cassiterite, similar to the zwitter at Altenberg. The ore deposit here war worked intensely in the old days. The collapse of the caves dug here caused the formation of a sink of about 25 m depth and a chimney of broken rock going down to a depth of 80 m below the bottom of the sink. Southwest of this zwitter block, there is another,similar one, in the vicinity of the line of contact between granite and gneiss. This second zwitter formation was not found by our predecessors. During the prospecting operations of the past few years, approximately 0.5 million tons, containing 0.5% tin have been struck here. The cassiterite of this greisen ~~form~~ formation, the so-called external greisen, is extremely well dombined with the other components of the greisen in some places, so that the ~~xxxxxxxxxxxx~~ tin content recoverable by processing is only 0.33% , corresponding to a recoverable amount of 1,600 tons of tin.

This granite has been penetrated by a second, more recent granite peak. This second granite is more recent than the tin mineralization of the first thrust, and borders it with a clearly defined pegmatitic marginal texture.

This interior mass has also been autometasomatically converted into a medium- to coarse-grained greisen with tin, wolfram, copper and bismuth content. The pegmatitic marginal texture has been turned completely into coarse-grained greisen at higher levels, and into coarse-grained greisen and almost pure quartz at lower levels. This so-called quartz-dome contains large quantities of wolframite at its apex, and this wolframite was mined at the beginning of the 20th century.

2) Operational data

a) Methods of prospecting

After reopening of the old tunnel, the granite mass was more closely investigated by the building of strike tunnels, and the Southwestern ore deposit in the external granite was found during these operations. The deposit was laid open on the tunnel level, on levels 30 and 60 m above the tunnel level, and on

SECRET

the level of the old blind shaft, 30 m below the tunnel level, by the building of strike tunnels.

At the same time, the shaft was deepened to 90 m and the internal greisen mass was laid open on the 90 m level and on the 60 m level. The continuation of this greisen mass toward greater depth was investigated from the 90 m level by means of depth drilling.

After assaying, an average sample from all workings on the 30, 60, and 90 m levels, weighing about 300 tons, was mined and put through the processing plant of the Tannenbergsthal mine. This showed the recoverable average content of the ore reserves above the 90 m level as follows:

Recoverable metal content in kg per ton of processing throughput:

Sn	WO_3	Cu	Bi
1.470	0.750	2.34	2.33

A mathematical study of the costs of mining showed that the metals, despite the low contents, can still be produced at not excessive costs with a high rate of throughput and inexpensive mining methods. The Ministry of Economics approved the construction of a processing plant and thereupon the mine workings were immediately begun.

The production costs per kg of metal in the concentrate were estimated at:

Sn..... 9.- RM

WO_3 ...15.- RM

Bi ....30.- RM

Cu .... 0.70 RM

b) Ore reserves

The table below shows the ore reserves of the Sadisdorf copper mine:

		% Sn	Sn content in tons
a) External greisen	0.5 million tons	0.5	2,500 (definite)

b) Internal greisen	Level	Million tons	Sn,%	Sn, tons	WO_3,%	WO_3,tons	Bi,gr/t	Bi,tons
	-30 -90 (definite)							
	-90 -120							

SECRET

b) Internal greisen

Level	Million tons	Sn,%	Sn,tons	WO_3,%	WO_3,tons	gr/t Bi	Bi,tons
-30 -90 (definite)	1.0	0.196* (0.147**)	1960	0.100* (0.075**)	100	310* (233**)	310
-90 -120	1.5	0.167	2500	0.104	1760	58	87
-120 -150	2.1	0.109	2290	0.020	420	64	134
-150 -180	3.3	0.126	4160	0.081	2670	36	119
-180 -210	5.2	0.151	7900	0.036	1870	29	150
(-90 -210 probable)							
Total	13.1	0.144	18800	0.059	7720	61	800

*Estimated on the basis of 75% yield from processing

**Recoverable according to a processing test performed on a throughput of 300 tons.

c) Methods of mining, haulage, ventilation, and water removal

It had been planned to carry out the working of the mine by the magazine method with rock pillars, removing the rock pillars from the top down during the emptying of the magazines. The first stage was to include all ore above the 90 m level. The removal from the magazine was to be carried out over a grate, similar to the method used in the mining of block rubble, where rocks of excess size are broken up. The ore was then to be conveyed over rollers to the storage bunkers of the two haulage tunnels on the haulage level, from where it was to be brought into the bunker for the conveyor bucket. Conveyor bucket haulage was planned in the main shaft. From the main shaft the ore was to be hauled by cable railway or locomotives to the processing plant. The construction of the processing plant was begun at some distance from the present location of the conveyor shaft, since it is expected that the ground will sink at a later time. The mine workings have been largely completed.

The present main shaft is a downcast shaft; the ventilation rises through the magazines. Removal of the mine air was to be carried out through overhand stopes and through the broken rocks to the surface. Since there is great danger of contracting silicosis in this mine, the mine was to be operated only in one shift, blasting operations to take place at the end of the shift.

The water seepage is slight, amounting to 0.5 cu m per minute on the average.

SECRET

During heavy rains or sudden melting of snow this figure may by increased to a multiple over a short period of time.

d) Production and contents of crude ore

A throughput of 400 to 500 tons per day was planned. For the metal contents of the crude ore cf. section b).

e) Processing methods

Wet-mechanical processing was planned:

Jaw crusher - conical crusher - ball mill - swing screen - buddles.

The waste and the concentrates were to be put through a flotation process afterward for complete recovery of the bismuth.

f) Production of concentrate

The following production of metal in the concentrate was planned:

188 tons per year of Sn

60 " " " of WO_3

24 " " " of Bi

24 " " " of Cu.

g) Efficiency

The expected average output of metal per shift of the total crew has been estimated at:

1.79 kg Sn

0.57 kg WO_3

0.23 kg Bi

0.23 kg Cu

2.82 kg of metal.

III. Tannenberg

1) Geological review

At the Western edge of the Karlsbad-Eibenstock granite massif, there is a tube-shaped ore deposit on the crest of the Ore Mountains, near the village of Tannenbergsthal, located directly at the contact line between granite and contact shale. It extends for a length of about 250 m. The deposit consists of coarse- to medium-grained greisen which contains topaz, and which bears primarily the

SECRET

Declassified in Part - Sanitized Copy Approved for Release 2012/04/04 : CIA-RDP82-00039R000100060052-8

following ores: Cassiterite, some arsenopyrite, pyrite, bismuth in its native state, copper pyrite, and most likely also complex copper-bismuth ores.

2) Operational data

a) Prospecting methods

The prospecting was carried out exclusively by ~~underground workings~~. A tunnel was built under the known sink at the outcropping. The ore deposit was laid open at the tunnel level and then worked above and below the tunnel level by building of a blind shaft of of overhand stppes, at intervals of 30 m in depth.

b) Ore reserves

The above operations have opened up a reserve of 250,000 tons of ore with 0.75% Sn and 1,875 tons of Sn in weight. The refining of the tin concentrates by flotation will lead to the recovery of approximately 19 tons of bismuth.

The actual bismuth content of the greisen is probably higher than that, since the refining of the concentrates only recovers the bismuth which can be obtained by the wet mechanical method together with the tin ore. A secondary flotation of the waste heaps to recover the bismuth is not carried out. The wastes from the washing process have also not been investigated for their bismuth content until now. The investigations of the processing method, which have been carried out so far, were concerned only with the tin content of the wastes.

c) Methods of working, hauling, ventilation, and water removal

The method of working choses is that of continuous mining in sections. The deposit is divided into sections running laterally to the shale contact. These sections are blasted out starting from the sill to the top of the vein in stopes of 3 to 4 m height. The rubble obtained by blasting flows on top of the packing to the ore rollers carried along on the sill, with only little manual labor required. After one section has been blasted out, a roller on the top of the vein hauls in packing and the empty space which has been blasted out is completely filled again. After packing, the next section is blasted out, and so forth. This is a very efficient process and permits the working of the entire ore deposit. The ore which has been mined is removed manually from the rollers on the next lower level, hauled to the blind shaft and then hauled to the tunnel adit along the tunnel by diesel locomotives. The stopes on the top of the deposit which go all the

SECRET

way to the surface, and the prospecting stopes in the deposit itself, have created a good natural ventilation which is quite independent of the existing air circulation through the tunnel. The fresh air coming in through the oblique stopes blow directly to the face and prevent any exhaust gases of the diesel locomotives from collecting at places where personnel is occupied. Blind tunnels for prospecting purposes are ventilated by compressed-air fans.

The seepage is slight. It amounts to approximately 0.45 cu m per minute. The main pumping installation is located on the 60 m level of the blind shaft. The water here is pumped to the level of the tunnel and then runs off through the tunnel. It contains large amounts of hematite sludge. Thus an inactive gallery was converted into a settling tank, where lime is used to precipitate the colloids.

d) Crude ore production and contents

	1943	1944
Crude ore production, tons	17,981	16,874
Crude ore content of Sn,%	0.76	0.72
Crude ore content of As,%	0.30	0.24

e) Processing method

The processing is by a wet mechanical method, primary by means of buddles. The chief deficiency of this method is the lack of special apparatus for the crushing of the intermediary products. These are returned to the main ball mill, causing it to be overloaded and to suffer losses from grinding, because the greisen contains large quantities of abrasive material (topaz). The flowsheet of the processing method is included.

f) Production of concentrate

	1943	1944
Sn concentrate, tons	230.6	255.9
Sn content,%	40	31.5
Sn content, tons	92.76	80.71
As concentrate, tons	39.59	26.41
As content, %	25.8	49.5
As content, tons	10.29	12.70

SECRET

 table cont'd on next page

Bi content, %	2.5	5.1
Bi content, tons	1.01	1.27
Cu content, %	7.2	8.9
Cu content, tons	2.95	2.25
S content, %	19	23
S content, tons	7.29	5.80

The arsenic concentrate is shipped as mixed concentrate to the "Staatliche Huetten- und Blaufarbenwerke" where bismuth, copper, arsenic and sulfur are almost completely recovered.

g) Efficiency

The average ~~xxxx~~ output of metal per shift of the total crew, in kg, was:

	1943	1944
Sn	3.59	3.0
As	0.48	0.53
Bi	0.04	0.05
Cu	0.11	0.09
S	0.28	0.22

IV. "Bergsegen" mine, Zschorlau

1)Geological summary

At the contact area of the granite formation of Aue in the Ore Mountains, between the village of Zschorlau and the Mulde river, there occurs a zone of pneumatolytical, quartz-bearing wolframite veins which, in addition to wolframite, also bear bismuth in its natural state and bismuthinite. In accordance with the type of origin of these veins, they do not go down to great depths. The ore reserves of this mine are therefore limited.

2) Operational data

a) Prospecting methods

Purely underground ~~xxxxxx~~ prospecting methods - building of galleries, strike tunnels, stopes, and small shafts - about 60 parallel vein offshoots were struck. Not all of them were found to be workable. For determining the propagation to greater depths of the lowest of these veins, a test drilling was conducted. It showed that the offshoots which are already not workable at the main tunnel level do not increase in thickness toward greater depths.

SECRET

b) Ore reserves

The ore reserves still available at Zschorlau, after the best portions of the deposit have been mined, amount to the following:

Crude ore, tons	90,000
WO_3, %	0.5
WO_3, tons	450
Bi, tons	20

c) Methods of mining, haulage, ventilation and water removal

All mining is carried out by overhand stoping. As the veins are thin (10 to 20 cm), the associated rocks on the ceiling are first blasted out, the rubble used for filling, if necessary, and then the vein attached to the vein wall on the sill is worked. The haulage within the workings to the rollers situated in recesses in the filling is carried out on wheelbarrows. At higher levels the ores are hauled by hand on mine carts to chutes and conveyed to the tunnel level. There carts are made by hand up into trains, and the trains then pulled to the processing plant, located at the tunnel ~~ax~~ adit by battery-driven mine locomotives.

For ventilation, the natural draft through tunnels and stopes is used. Blind tunnels are ventilated by compressed-air fans.

All seepage water is drained to the tunnel level. The slight seepage which occurs at levels below the tunnel level is pumped to the tunnel by means of compressed-air pumps. The total seepage is between 0.3 and 0.6 cu m per minute.

d) Crude ore production and contents

	1943	1944
Crude ore, tons	23,058	17,023
% WO_3	0.66	0.6

e) Processing method

The processing is a wet mechanical method, comprising tubs and buddles. The concentrates obtained thereby are turned into calcium wolframate in a wolfram leaching plant. The residues ~~fxxx~~ from this process, containing bismuth - the bismuth in the native state and the bismuthinite are concentrated together with the wolframite - are recovered and sold to the "Staatliche Huetten- und Blaufarbenwerke". The flow-sheet is appended.

SECRET

f) Production of concentrate

~~x~~	1943	1944
Concentrate, tons	223.16	195.59
WO_3 content, tons	130.4	115.9
WO_3 content,%	66	59
Bi from residues, sold to the Bi-processing plant, tons	2.0	3.5

g) Efficiency

The average output of metal, in kg, per shift of the total crew, was:

	1943	1944
WO_3	1.67	1.44

D. Summary

The amount of bismuth reserves available in the region of the Mining Office of Freiberg is shown in the table below:

a) Bismuth mining:	tons
1. Johanngeorgenstadt	120
2. Schneeberg	335
3. "Gottes Segen" mine, nr. Antonsthal	50
4. "Himmelfahrt Christi" mine, Gerstenberg Mt. near Muldenhammer	50-60
Total of pure bismuth mining	555-565
b) Tin - wolfram mining	
1. Altenburg	400 -530
2. Sadisdorf copper mine	800
3. Tannenberg	19
4. Zschorlau	20
Total Tin- wolfram mining	1,240 - 1,370
Total of a) and b)	1,795 - 1,925

Bismuth is also obtained as a byproduct during the lead refining of the highly thermal lead-zinc veins of the Freiberg "Himmelfahrt" mine.

SECRET

The bismuth content of the concentrate is 0.18% on the average, or, in terms of lead, 0.324 %.

The mine has the following ore and lead and thus also bismuth reserves:

	ore, million tons	lead, tons	bismuth, tons
Definite and probable	0.385	15,000	48.5
Possible, at 900 m depth	1.8	65,000	210.5
Total	2.185	80,000	259.0

The total bismuth reserves of the region of the Freiberg mining office are thus increased to 2055 to 2185 tons.

Freiberg, 28 Sep 1945.

SECRET

APPENDIX III. FLOW SHEET OF TIN PROCESSING AT TANNENBERG

Legend: Wage - scale

Kreiselwipper - rotary tippe r

Rost - grate

Kettenaufgabe - chain conveyor

Backenbrecher - jaw crusher

15 mm Vibratorsieb - 15 mm vibrator screen

Symonsbrecher - Symons crusher

Entwässerungsklassierer - dessication grader

Kammeraustragsmühle - chamber mill (?)

jetzt ausser Betrieb - at present not in operation

Setzmaschine - settling machine

Konzentrat - concentrate

zur Austragsmühle - to the mill (?)

Konzentrat zur Bi Flotation - concentrate for bismuth flotation

Humbold Wurfherd (WH) - buddle

Humbold Schnellstossherd (WH) - rapid buddle

Humbold Schlammherd (Sch H) - sludge buddle

Eindicker - concentrator

Durchsatz 50 t/ 24 St - throughput 50 tons per 24 hrs.

APPENDIX IV. FLOW SHEET OF THE WOLFRAM PROCESSING AT ZSCHORLAU

Wage- scale

Wipper - tipper

Stangenrost - bar grate

Kettenaufg. - chain conveyor

Symonsbrecher - Symons crusher

Rost - grate

Umlegeplatte - tipping plate

Läutertrommel - ~~[illegible]~~ picking drum

Klaubband - hand picking conveyor

Berge - deap heaps

Siebkugelmühle - sifting ball mill

Doppeldecker Vibratorsieb - ~~[illegible]~~ double-layer vibrator screen

Ausgleichsspitze - compensation point

zum System B - to system B

Setzmaschinen - settling machines

Nachwaschherd - Secondary washing buddle

Entwässerungsklassierer - ~~[illegible]~~ desiccation grader

Flintsteinmühle - flint mill

Konzentratnachwaschherd - secondary washing buddle for concentrate

Fertigkonzentrat (...) - Finished concentrate (formerly sent to flotation, now directly shipped to refining plant)

z. Eindicker - to the concentrator

WH-Humbold Wurfherd - buddle

SH=Humbold Schnellstossherd - rapid buddle

Note: The flow sheet of the processing plant at Sadisdorf, mentioned in the text, is missing in the document.

The two tables of the ore reserves at Johanngeorgenstadt and Schneeberg are duplicates of the tables included in translation #ST 51 and are to be found there.

Appendix IV

Processing throughput, fiscal yr 1940

Processing period	Area	High-content ore, wet, in tons	Washed ore, wet, in tons	Total wet, in tons	U_3O_8 in tons	Ra in mg
I, Apr.-June 1940	Carryover 1939/40	0.499	1.5195	2.0185		
	Werner shaft	0.697	18.9635	19.6605		
	Einigkeit shaft	0.080	5.052	5.132		
	Edelleut tunnel	0.121	4.295	4.416		
Total		1.397	29.8300	31.2270		
II July-Dec 1940	Werner shaft	1.894	20.075	21.969		
	Einigkeit shaft	—	—			
	Edelleut tunnel	0.503	3.049	3.552		
Total		2.397	23.124	25.521		
III Jan-Mar 1941	Werner shaft	1.017	22.715	23.732		
	Einigkeit shaft	—	0.273	0.273		
	Edelleut tunnel	0.676	20.599	21.275		
Total		1.693	43.587	45.280		
Total for entire year		5.487	96.541	102.028	7.9462	2,224.936

Appendix II

Production of concentrate

Processing period	Input: Quantity, wet tons	Input: U_3O_8 content, %	Input: U_3O_8 cont. tons	Concentrate: Quant, wet tons	Concentrate: U_3O_8 %	Concentrate: U_3O_8 tons	Concentrate: Ra mg	Yield %
I Apr-June 1940	31.227	–	–	3.988	55.3+)	2.18144	610.526	–
II July-Dec 1940	25.521	–	–	3.997	50.0+)	1.97959	554.034	–
III Jan-Mar 1941	45.280	–	–	4.830	59.4+)	2.83145	792.342	–
	102.028	approx 7.8	7.9462	12.815 = 12.68709 dry	55.115	6.99248	1.956.902	88%

Appendix V

Shipments of concentrate

Consignee	Shipment date	Concentrate, dry, kg	U_3O_8 cont., %	Content by weight U_3O_8, tons	U, tons	Ra, mg
Auer, Berlin	9/28/40	2,986.86	55.3	1.65173	1.40084	462.280
	8/23/40	992.10	58.5	0.58038	0.49222	162.433
Total		3,978.76	56.098	2.23211	1.89306	624.713
Buchler, Braunschweig	2/18/41	2,442.30	50.2	1.22603	1.03969	343.140
	7/1/41	1,702.88	59.4	1.01151	0.85787	283.022
	28/1/41	496.35	55.9	0.27746	0.23528	77.621
Total		4,641.53	54.185	2.51500	2.13284	703.783
Chemical works, Treibach	3/1/41	2,463.10	52.1	1.28327	1.088350	359.140
	8/15/41	1,603.50	60.0	0.96210	0.815957	269.226
Total		4.066.60	55.215	2.24537	1.904307	628.406
All shipments		12.687.04	55.115	6.99248	5.930207	1,956.902

33

Appendix IVa

A. Investments from gov't-backed loans ("Large-scale investments")

Area	Type of work	Planned advance m	Planned costs RM	Actual advance M	Actual costs RM	Remarks
1) Werner shaft	a) Werner shaft sinking pit head on 6th level Cross-cut	80 316.1 m^3 20	153,700	55.4 376.1 m^3 16.2 178.8 m^3	134,729.59	Due to melting of snow, the flow of water in the main shaft increased steadily, stopping the shaft-sinking operations during March and April. The planned depth of 80 m was therefore not reached.
	b) Connecting gallery between N. "Schweizer" hanging offshoot and Danieli tunnel cross-cut	29	10,000	29.1	10,033.60	Carried out.
Total		129 376.1 m^3	163,700	100.7 555.9 m^3	144,763.19	
2) Einigkeit shaft	a) 12th level, W. gallery to "Geister" vein	65	17,000	64.5	16,744.49	Digging suspended after hitting granite, since the management considered the operations too expensive in the extremely tough, solid rock.
	b) 10th level gallery to "Bergkittler" and Schweizer vein, gallery Strike tunnel in "Schweizer" vein	60 40	24,400	63.5 106.6	30,147.77	Narrow vein, contains some ore
	c) "Schweizer" vein, connecting shaft from 12th level to 10th level	30	9,500	31.9	12,905.75	Carried out
	d) Breakthrough to "Werner" shaft from 12th level					
	Overhand stoping Aligning tunnel Gallery	87 10 20	46,300	84.2 10.6 —	36,406.12	
3) Edelleut [illegible]	a) 8th level, E gallery [illegible]	320	[illegible]	352.8	[illegible]	Gallery not built for operational [illegible] Vein has good [illegible]

	"Schweizer" vein					
	c) "Schweizer" vein, connecting shaft from 12th level to 10th level	30	9,500	31.9	12,905.75	Carried out
	d) Breakthrough to "Werner" shaft from 12th level					
	Overhand stoping Aligning tunnel Gallery	87 10 20	46,300	84.2 10.6 —	36,406.12	Gallery not built for operational reasons
3) Edelleut tunnel	a) 8th level, E gallery to "Francisci" vein and driving of level along "Francisci" vein	320 60	89,000	352.8 30.3	70,960.73	Vein bears good quantities of ore. Was investigated over a length of 30.3 m. Further driving & mining
	b) 8th level gallery to "Glückauf" vein Driving of level along "Glückauf" vein and building of overhand stope	70 70 45	43,600	67.2 73.5 22.3	34,946.82	Vein was reached at border between shale and granite. Contained no ore. Not finished due to lack of personnel.
	c) Tunnel floor, widening of compressor room	250 m³	5,000	248 m³	4,223.62	Carried out
	d) Enlarging of ventilator room, and of connecting tunnel between the old and the new tunnel	53 m³	500	53 m³	5,336.28	Brittle rock, required accidental concrete work

Appendix I

Fiscal year 1940
Crude ore production

Month & Yr	Werner shaft Rich ore, t	Werner shaft Wash ore t	Einigkeit shaft Rich ore t	Einigkeit shaft Wash ore t	Edelleut tunnel Rich ore t	Edelleut tunnel Wash ore t	Total Rich ore t	Total Wash ore t	Total ore t	tons of U_3O_8	mg of Ra
Apr. 1940	0.453	24.0915	0.055	3.392	0.003	3.720	0.511	31.2035	31.7145		
May	0.378	3.073	0.025	1.740	–	0.575	0.403	6.388	5.791		
June	0.379	1.521	–	–	0.118	0.701	0.857	2.222	3.079		
July	–	3.673	–	–	0.110	0.287	0.110	3.960	4.070		
Aug.	0.042	3.552	–	–	0.188	0.609	0.230	4.161	4.391		
Sep.	0.388	2.716	–	–	0.044	0.936	0.432	3.652	4.084		
Oct.	0.086	2.966	–	0.020	0.065	1.224	0.151	4.210	4.361		
Nov.	0.522	4.805	–	0.160	0.096	4.849	0.618	9.814	10.432		
Dec.	0.072	2.717	–	0.013	0.112	2.381	0.184	5.111	5.295		
Jan. 1941	0.355	5.512	–	–	0.188	3.405	0.543	8.917	9.460		
Feb.	0.441	4.573	–	–	0.224	6.301	0.665	10.874	11.539		
Mar.	0.132	2.554	–	–	0.152	2.955	0.284	5.509	5.793		
Fiscal yr. 1940 Total:	3,608	61.7535	0.080	5.325	1.300	27.943	4.988	95.0215	100.0095	7.789	[illegible]

Appendix IVB

A. Investments from gov't backed loans (cont'd)

Area	Type of work	Estimated cost	Actual cost	Remarks
	II, Processing			
	a) Flotation experiments etc.	2,000	2,264.90	The experiments brought no results
	Total: Processing	2,000	2,264.90	
	III Construction work			
1) Werner shaft	a) P.O.W. barracks	12,000	10,500.98	Completed
	b) Immersion plant for mine timber	12,000	2,883.90	To be finished in fiscal yr 1941
	c) Masonry work on sawmill	1,000	—	Not carried out due to labor shortage
	d) Rebuilding of repair shop	—	224.98	Had not been planned, but turned out to be essential
2) "Einigkeit" shaft	a) Construction of an attic room in bldg. 824	1,000	808.24	Completed
3) "Edelleut" tunnel	a) Expanding of the sanitary facilities (bath, locker room, etc.) in the pit bldg.	22,000	21,840.93	Completed
	Total: Construction work:	48,000	36.259.04	
	IV. Machinery			
1) Werner	a) Cables	6,000	—	Will be delivered in spring of 1941

	bldg. 824	1,000	808.24	Completed
3) "Edelbert" tunnel	a) Expanding of the sanitary facilities (bath, locker room, etc) in the pit bldg.	22,000	21,840.93	Completed
	Total: Construction work:	48,000	36.259.04	

	IV. Machinery			
1) Werner shaft	a) Cables	6,000	—	Will be delivered in spring of 1941
	b) Ventilators	2,700	2,658.60	Above estimate, because 7 ventilators were needed
	c) 1 lathe	4,000	3,672.30	delivered
	d) 2 air tanks for compressor	5,000	4,660.–	delivered
	e) Parts & spare parts for new compressor	4,000	4,521.72	above estimate due to necessity of procuring additional spare parts
	f) 1 centrifugal pump with motor for drinking water supply	500	499.–	delivered
	g) Spindle for depth indicator on conveyor machine	800	784.20	delivered
	h) Signal & telephone system for shaft	3,300	3,263.72	delivered
	i) Down-payment for new conveyor tower	6,500	—	not paid yet
	k) Down-payment on new conveyor machine	21,000	2,034.35	only partial payment made
	l) Drilling machines and accessories	3,000	5,747.88	Above estimate - larger purchases

	[illegible] for shaft			
	i) Down-payment for new conveyor tower	6,500	—	not paid yet
	k) Down-payment on new conveyor machine	21,000	2,034.35	only partial payment made
	l) Drilling machines and accessories	3,000	5,747.88	Above estimate – larger purchases than planned were required
	m) Surface telephone system	—	2,689.09	Not planned, but purchase was necessary
	n) 1 drill upsetting machine	—	344.70	
	o) 1 motor		242.–	
) Einigkeit shaft	a) Cable for pump & compressor	1,800	622.80	Order only partially filled
	b) Ventilators	2,000	1,243.30	4 ventilators purchased
	c) 2 Beien compressed-air winches	1,300	1,214.10	
	d) 1 Flender drive for compressor	1,300	1,313.19	
	e) 1 centrifugal pump with motor	5,500	5,465.10	
	f) Mine telephones	800	590.60	
	g) Drilling machines & accessories	2,500	347.60	1 jackhammer & accessories bought.
	h) 1 rubber-wheeled cart	—	1,142.85	Required for project 12; Required for hauling of timber — Had not been planned in estimate
	i) 1 transformer	—	542.84	Required for pumping station
	k) 1 acetylene generator	—	209.97	Required for metal shop
	l) 1 grinding machine	—	347.–	
"Edelhut" tunnel	a) Cable	3,800	—	Could not be obtained yet
	b) High-pressure ventilator	1,000	—	Will not be purchased until fiscal

j) 1 transformer	—	[illegible] required for pumping station	been planned estimate
k) 1 acetylene generator	—	209.97	Required for metal shop
l) 1 grinding machine	—	347.–	

3) "Eckhart" tunnel

a) Cable	3,800	—	Could not be obtained yet
b) High-pressure ventilator for 8th level	1,000	—	Will not be purchased until fiscal yr. 1941
c) Ventilators	1,000	—	Not required
d) Centrifugal pump with motor for 8th level	5,500		Will not be purchased until fiscal yr. 1941
e) Transformer, 300 kW	4,000	5,049.72	
f) 1 Flender drive for compressor	1,600	1,537.76	
g) 2 air tanks	3,200	3,236.–	
h) 1 rocking mill for ore dressing	400.–	406.85	
i) 1 centrifugal pump for compressor	400.–	358.–	
k) Mine telephones	2,400	1,145.60	Order only partially filled
l) Drilling machines & accessories	2,500	1,184.22	
m) 1 winch	—	1,050	Not planned in estimate, but required
n) 1 motor	—	225.50	
Machinery: Total	97,000	58,349.46	

for compressor

k) Mine telephones	2,400	1,145.60	Order only partially filled
l) Drilling machines & accessories	2,500	1,184.22	
m) 1 winch	—	1,050	Not planned in estimate, but required
n) 1 motor	—	225.50	
Machinery; Total	97,000	58,349.46	
I, II & IV, total:	147,000	96,873.40	

Large-scale investments, I through IV, total: 546,000 453,307.96

− 29,514.75 for value of ore mined during operations

423,793.21

Appendix V

B) Fiscal year 1940. Current investments charged to interest

Area	Type of work	Planned advance, m	Planned Costs RM	Actual advance, m	Actual Costs RM	Remarks
1) Werner shaft	a) "Bergkittler" vein, "Danieli" tunnel level, direction S	50	9,500	59.2	8,902.07	investigation of vein is being continued. Vein only a fissure.
	b) "Bergkittler" vein, 4th level, direction S	6	1,000	6.3	621.79	Vein only a fissure
	c) "Bergkittler" vein, 5th level, direction N	80	15,600	67.9	11,132.25	Vein begins to bear ore. Ore was hit and mined. For this reason, the planned advance was not attained.
	d) "Bergkittler" vein, 5th level, direction S	20	3,900	40.0	6,585.16	Vein promising. Advance was therefore continued. Some wash ore was mined.
	e) "Schweizer" vein, "Danieli" tunnel level, direction S	100	28,000	96.4	24,878.96	Old mines were dug up. Advance difficult due to brittleness of ceiling. Vein dead in most places, heavily foliated. Some ore found locally.
	f) "Schweizer" vein, 4th level, direction S	60	11,400	59.5	7,082.67	Dead vein
	g) Blasting of water reservoir space, "Barbara" tunnel	—	—	—	75.82	Additional project.
	Total	316	69,400	329.3	59,278.72	
2) "Einigkeit" shaft	a) "Josefi" vein, 12th level, direction S	80	17,200	54.2	11,921.18	The vein is at first ore-bearing then splits up completely, so that work was not continued
	b) "Schweizer" vein, center face, 7m above 12th level	80	17,600	111.4	22,676.30	Center face was driven forward as far as the 2d South stope. Dead vein.
	c) "Schweizer" [illegible] 12th	[illegible]				

tunnel						
	Total	316	69,400	329.3	59,278.72	
2) "Einigkeit" shaft	a) "Josefi" vein, 12th level, direction S	80	17,200	54.2	11,921.18	The vein is at first ore-bearing then splits up completely, so that work was not continued
	b) "Schweizer" vein, center face, 7 m above 12th level	80	17,600	111.4	22,676.30	Center face was driven forward as far as the 2nd South stope. Dead vein.
	c) "Schweizer" vein, 12th level, direction S	30	6,600	30.0	8,620.88	Dead vein. Tunnel had to be reinforced.
	Total	190	41,400	195.6	43,218.36	
3) "Edelleut" tunnel	a) "Glückauf" vein, 5th level Realignment by: building of gallery overhand stope Strike tunnel	50-60 30 –	20,700	27.3 11.1 44.1	20.087.14	The vein was struck in the gallery after 27.3 m. A 44.1 m long strike tunnel was built along the vein which seemed promising. The stope of 11.1 m height built at the end of the tunnel showed traces of ore.
	b) "Glückauf" vein, 4th level, alignment of a vein offshoot to the N	—	—	22.3	2,703.04	A N. offshoot of the "Glückauf" vein, known at higher levels, was struck by a gallery and investigated. Vein is promising.
	c) "Francisci" vein, 8th level, direction N	—	—	12.5	1,432.94	Vein is ore-bearing
	d) "Francisci" vein, 8th level, direction S	—	—	7.0	1,082.41	Vein is ore-bearing
	Total	80-90	20,700	125.3	25,305.53	
	Total 1–3	586-596	131,500	650.2	127,802.61 -62,750.25 65,052.36	value of ore mined during operations

Additional project

STAT

Page Denied

Appendix I

Possible reserves of bismuth ore at Johanngeorgenstadt

No.	Vein	Working area	Workability coefficient	average length m	average dip	ore yield tons/sq.m	ore yield on basis of vertical depth, t/sq.m	average probable ore yield on basis of depth: tons/m vert. depth	bismuth, kg	cobalt kg	nickel kg
1	"Hochneujahr"	below "Gnade Gottes" tunnel, 240 m level	0.25	400	80°	0.500	0.560	56	130	—	—
2	"Segen Gottes"	above 26 Lachter gallery, 250 m	0.25	150	75°	0.375	0.390	15	37.5	—	—
3 4 5	"Gustav" "Daniel" "Bau auf Gott"	50 m above and 100 m below 46 Lachter gallery = 150 m	0.25	250	80°	0.250	0.260	16.25	40.6	—	—
6	"Erzengel"	"Eleonora-Gnade Gottes" tunnel, 65 m + 150 m below = 215 m	0.20	450	70°	0.375	0.395	35.5	88.75	—	—
7	"Engelsfreude"	200 m below "Liebe Gottes" tunnel	0.20	250	75°	0.500	0.580	29	72.5	—	—
8 9 10 11 12	"Immanuel" "Christian" "Blühend Hoffnung" "Brüderliche Treue" "Himmelsfürst"	50 m above and up to 200 m below "Liebe Gottes" tunnel = 250 m	0.25	500	70°	0.375	0.395	50	125	—	—
13 14 15	"Bergmannsglück" "Johannes" "Elias"										

9	"Christian"	50 m above and up to 200 m below "Liebe Gottes" tunnel = 250 m	0.25	500	70°	0.375	0.395	50	125	–	–
10	"Blühend Hoffnung"										
11	"Brüderliche Treue"										
12	"Himmelsfürst"										
13	"Bergmanns-glück"										
14	"Johannes"										
15	"Elias"										
	Probable ore reserves in Johanngeorgenstadt mines per m of vertical depth							201.75	494.35		

Accordingly possible ore reserves down to an average vertical depth of 225 m: 45,000 Tons of ore with approx. 110 tons Bi

Plus definite and probable reserves according to 1944 operations plan: 5,000 tons of ore with approx. 10 tons Bi

50,000 tons of ore with approx. 120 tons Bi

Appendix III

Possible ore reserves of the Schneeberg region

No.	Vein	Working area	Workability coefficient	average length, m	average dip	ore yield tons/sq.m	ore yield on basis of vertical depth, tons/sq.m	average probable ore yield on basis of depth			
								tons/m vertical depth	kg Bi	kg Co	kg Ni
1	"Walpurgis" "Georg"										